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Extracorporeal Membrane Oxygenation Cannula

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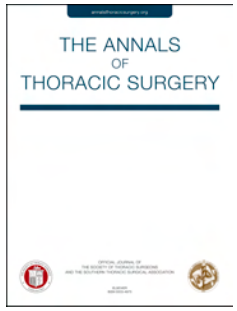

Ultrasound-Navigated MANTA™ deployment after Removal of Extracorporeal Membrane Oxygenation Cannula

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Running head: Percutaneous VA-ECMO Decannulation

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Abstract

The case provided suggests that ultrasound-navigated MANTA™ works well closing percutaneously the peripheral arterial ECMO cannulation site. Ultrasound use during ECMO decannulation can further diminish the possible device related technical failures (toggle or collagen protrusion through the vessel wall, toggle stacking into calcifications, or delivery failure of the collagen pad) leading to bleeding and vascular complications. Further studies are needed on this topic.

A true percutaneous approach for peripheral venoarterial extracorporeal membrane oxygenation (VA-ECMO) cannulation and decannulation has been longed for. As ECMOs are mostly implanted on emergency basis, pre-closure with suture-based devices for arteriotomy and femoral cut-down are inconvenient for this situation. More recently, a novel plug-based technique for post-closure of large bore arteriotomies, the MANTA™ (Teleflex Inc., Morrisville, NC, USA) has been reported [1]. In fact, recently, one case report has been published employing MANTA™ successfully for ECMO arterial decannulation [2]. However, after ECMO cannulation, the pre-measurement of depth from skin to vessel, which is a fundamental step of MANTA deployment, is considered impossible with puncture locating dilator of MANTA. In our clinical practice, we developed an ultrasound-navigated method of MANTA deployment following procedures requiring large-bore arteriotomy with favorable results. Herein, we report our modified technique of percutaneous ECMO decannulation with ultrasound-navigated MANTA™ vascular closure.

A 54-year old previously healthy male without ordinary medications went lifeless at work. Effective cardiopulmonary resuscitation was started and the patient was transferred with a LUCAS® chest compression system to our hospital. Return of spontaneous circulation with ST-segment elevation of electrocardiogram was confirmed on the hospital yard. In emergency coronary angiography, a total occlusion of the left anterior descending was successfully treated by percutaneous coronary intervention. However, due to recurrent ventricular fibrillation, initiation of VA-ECMO treatment was decided. The groin vessels were percutaneously cannulated with ultrasound guidance. A 17 Fr arterial and a 23 Fr venous cannula (HLS Cannulae, Maquet Cardiopulmonary, Rastatt, Germany) were used for the common femoral artery and vein, respectively, and a 8 Fr introducer sheath in the superficial femoral artery for limb perfusion (Super Arrow-Flex®, Arrow International Inc., Reading, PA, USA). The patient’s condition stabilized during five days of ICU stay, and decision to wean from ECMO was done. In the operation room, the arterial cannula was punctured[3] (Fig 1 A), and a stiff guidewire was advanced into the descending aorta (Fig 1 B). Then, diagonal depth from skin incision to vessel was measured by ultrasound via longitudinal view. The arterial line was clamped and cut, and the cannula was removed along the stiff guidewire (Amplatz Extra Stiff, Cook® Medical, Bloomington, IN, USA). Next, an 18 Fr Manta™ assembly (sheath + closure unit) was inserted along the guidewire (Fig 1 C). The toggle was released at the pre-determined depth during ultrasound guidance (Fig 1 D). At this step, ultrasound-image under longitudinal view confirmed that the toggle located appropriately inside the vessel and was attached to the anterior vessel wall (Fig. 2). Finally, during ultrasound guidance, the blue tamper tube was advanced along the suture line compacting the collagen pad and the stainless steel lock on to the vessel, while keeping pulling force on the toggle for 10 to 15 seconds. After confirming hemostasis, the 8 Fr leg perfusion sheath was successfully removed using an 8 Fr Angio-Seal™ vascular closure device (VCD). The venous line was withdrawn with a figure of eight skin suture and short compression.

After ECMO removal the patient spent 6 days on a general ICU (re-intubated twice for pulmonary edema) and on a step-down unit for another 6 days. On the 17th day after cardiopulmonary resuscitation and ECMO implantation he was discharged without any groin access related complications or gross neurologic dysfunction (only slight confusion).

Comment

Whilst employing the percutaneous cannulation technique and only manual and device compression (Femostop®, St. Jude Medical) after ECMO decannulation, significantly more vascular complications and persistent bleeding have been observed compared to surgical cannulation and decannulation [4]. Previously, two registry studies (incorporating 56 and 15 percutaneous cannula removal, respectively) have been published reporting the results of a suture-based Perclose ProGlide® (Abbott Vascular, Santa Clara, CA, USA) VCD for percutaneous ECMO decannulation and vascular closure [3, 5]. In both studies, two ProGlide® devices were employed, and in the study of Majunke an additional Angio-Seal™ (St. Jude Medical Inc. Minnetonka, MN, USA) vascular plug was also employed. The decreased bleeding complications frequency during our transcatheter aortic valve replacement (TAVR) experience encouraged us to attempt Manta™ also on peripheral VA-ECMO closures [6]. Our TAVR experience also suggested that ultrasound-navigated MANTA™ deployment further decreased the incidence of major bleeding complications [7]. The surgical preparation of groin vessels in percutaneously implanted ECMOs is unpleasant, time-consuming for the surgeon, and invasive for the patient. In contrast to the previously described ProGlide® device for percutaneous ECMO cannula removal [3, 5], the Manta™ VCD allows immediate procedural hemostasis without distressing manual compression at the insertion site once the Manta sheath is delivered, and only one device is needed instead of two or more suture-based devices. However, we advocate liberate use of ultrasound both during cannulation (to achieve a median anterior vessel entry) and decannulation (both to assess depth of correct anchor/toggle release and to verify adequate apposition of the intravascular toggle and the extravascular collagen pad). If percutaneous vascular closure after long-standing ECMO treatment (weeks) is judicious, remains to see.

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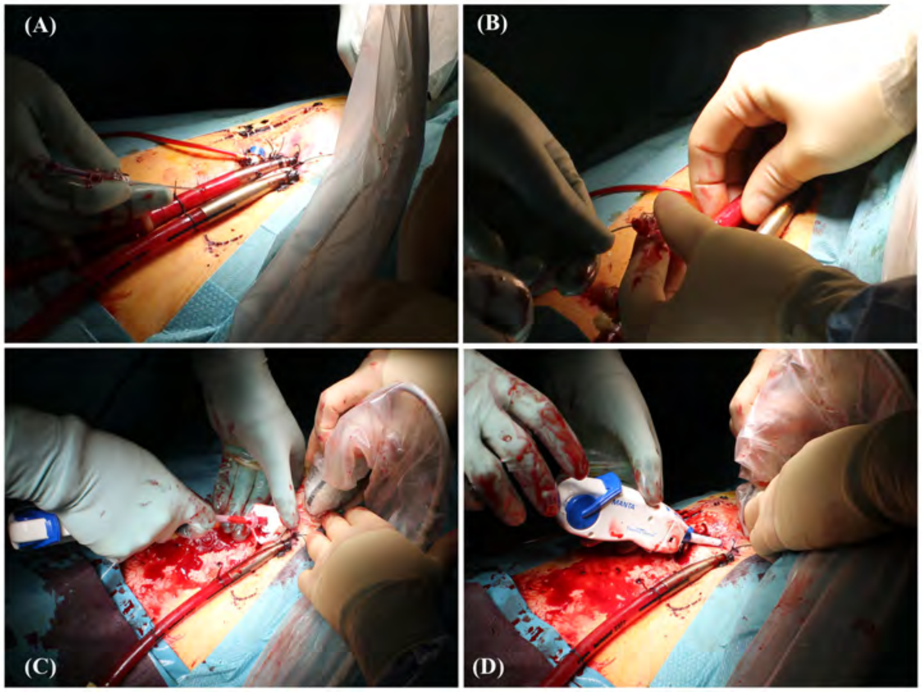
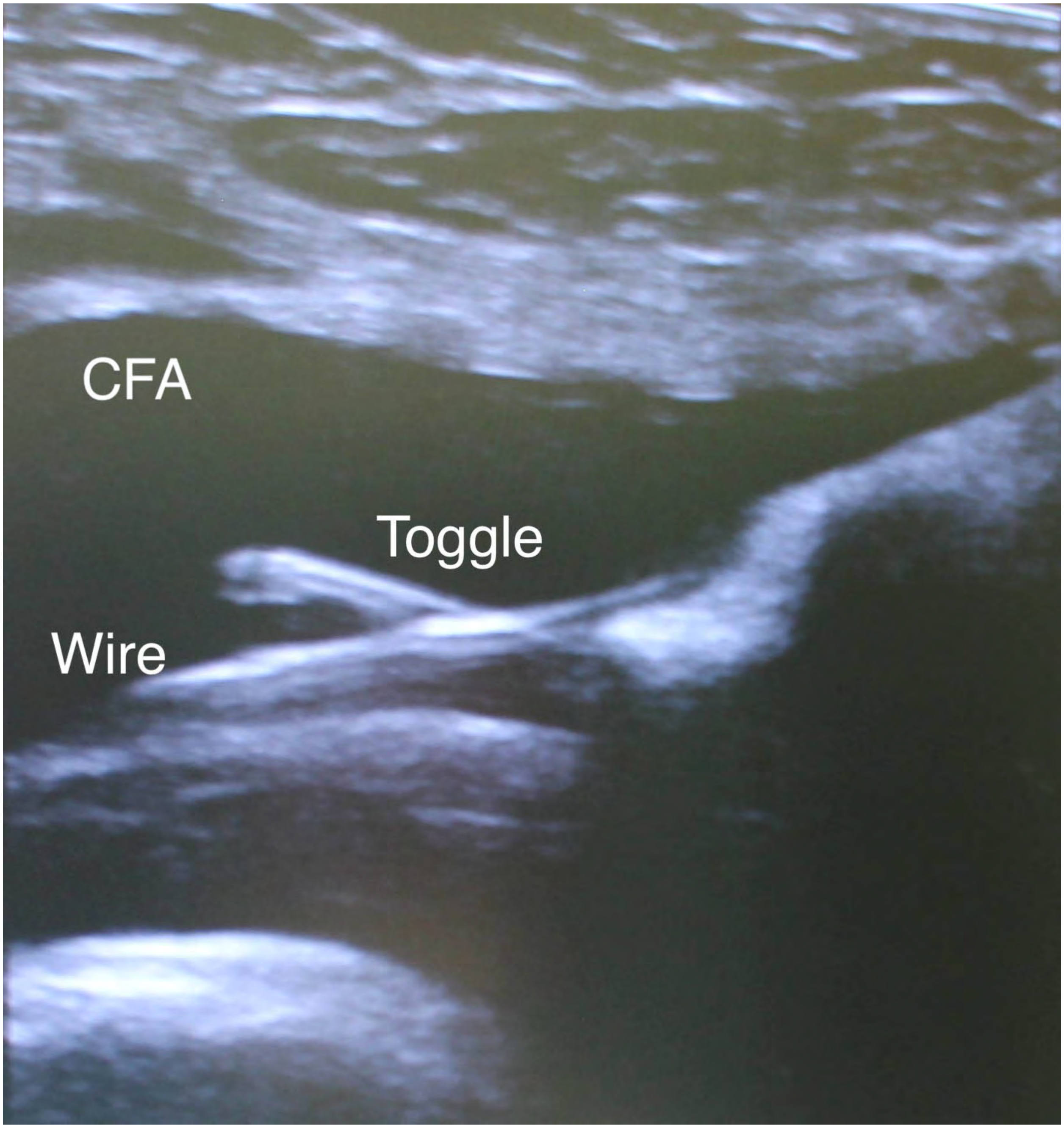
Figure Legends

Figure 1. Technical steps in ultrasound guided percutaneous removal of ECMO cannula. The diagonal depth of skin to vessel is optionally measured with ultrasound. The arterial line is clamped and cut, a stiff 0.035” guidewire is introduced through punctured arterial cannula into descending aorta (A-B). After the arterial cannula is withdrawn, the Manta sheath is introduced over the wire followed by engaging the Manta closure unit into the sheath (C). Then the linear ultrasound transducer (ideally 9-12 MHz) is placed longitudinally over the external iliac artery for visualizing the Manta assembly (D). The toggle is then released at the predetermined, ultrasound measured deployment level. Next, the assembly is withdrawn from the patient, keeping pulling force on the system. Then the blue tamper tube emerges, and is pushed down the suture line to secure the stainless steel lock onto the vessel and the compacted collagen pad. Finally, the puncture site of the limb perfusion sheath in the superficial femoral artery is closed with an 8 Fr Angio-Seal, and a deep skin suture put on the venous cannulation site together with short compression.

Figure 2. Ultrasound view of Manta toggle in common femoral artery. As the assembly is pulled back to pre-determined deployment length + 1 cm, the toggle becomes clearly visible and is released in the common femoral artery. Most importantly, the simultaneous ultrasound imaging confirms adequate sandwiching of the anterior vessel wall between the inferiorly pulled toggle and the superiorly compacted collagen pad.


(A)
(B)
(C)
(D)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